

We claim:

1           1.       A method for detecting misrepresentation of policy related information  
2 provided to an insurer by a policyholder where the information is used by the insurer in  
3 determining an amount of premium to be paid for insurance coverage provided to the  
4 policyholder, the method comprising:  
5           selecting a plurality of insurance policies to process with a predictive model;  
6           for each selected policy, deriving variables from policy related information provided by  
7           the policyholder in connection with the selected policy; and  
8           for each selected policy, applying the derived variables of the policy to the predictive  
9           model to generate a model score indicating the relative likelihood of misrepresented  
10          information provided by the policyholder or an expected adjustment of the  
11          premium on the policy.

1           2.       The method of claim 1, further comprising:  
2           collecting training data including a plurality of insurance policies having  
3           misrepresented information and a plurality of policies having misrepresented  
4           information;  
5           developing the predictive model from the training data; and  
6           storing the predictive model.

1           3.       The method of claim 1, further comprising:  
2           converting the model score to a fraud score indicating a probability of fraud in the  
3           policy.

1           4.       The method of claim 1, further comprising:  
2           converting the model score to the expected adjustment of the premium on the policy.

1           5.     The method of claim 1, wherein selecting a plurality of insurance policies further  
2 comprises:

3           for each policy, automatically determining start and end dates of a scoring period in  
4           which the determination of whether misrepresented policy information is to be  
5           determined.

1           6.     The method of claim 1, further comprising determining the start and end dates  
2 of the scoring period which the policy has consistent and complete data.

1           7.     The method of claim 6, further comprising:  
2           responsive to a policy not having consistent or complete data in the scoring period,  
3           defining an exclusion code providing a reason that the policy was not selected.

1           8.     The method of claim 6, wherein the insurance policies are workers'  
2 compensation insurance policies, and automatically determining start and end dates of the  
3 scoring period further comprises:  
4           defining the start and end dates such that all audit adjustments are contained between  
5           the start and end dates.

1           9.     The method of claim 1, wherein selecting a plurality of insurance policies further  
2 comprises:

3           for each policy, receiving a user defined scoring period to be scored for the policy; and  
4           automatically selecting those policies having consistent and complete data in the  
5           respective user defined time period from which the variables for the predictive  
6           model may be derived.

1        10.     The method of claim 9, further comprising:  
2        responsive to a policy not having consistent or complete data in the user defined time  
3        period defining an exclusion code providing a reason that the policy was not  
4        selected.

1        11.     The method of claim 9, further comprising:  
2        responsive to a policy not having consistent or complete data in the user defined scoring  
3        period, automatically suggesting a scoring period in which the policy has consistent  
4        and complete data.

1        12.     The method of claim 1, wherein deriving variables from policy related  
2        information further comprises:  
3        determining a plurality of peer groups of which the selected policy is a member; and  
4        for each peer group or set of peer groups of which the selected policy is a member,  
5        deriving variables from the policy information which attribute characteristics of the  
6        peer group or set of peer groups to the selected policy, or which compare the  
7        selected policy to other policies in the peer group or set of peer groups.

1        13.     The method of claim 12, wherein the derived variables estimate the probability  
2        of a dichotomous outcome or a certain distributional statistic of a continuous quantity for a  
3        policy, based on the peer group(s) of which the policy is a member.

1        14.     The method of claim 12, wherein deriving variables for the policy which  
2        compare the policy to other policies in its peer group(s) further comprises deriving variables  
3        that compare either at least one characteristic of the policy with at least one corresponding  
4        characteristic of the policies in its peer group(s).

1        15.    The method of claim 12, further comprising:  
2        for each of the plurality of peer groups, storing in a lookup table group statistics for  
3        policy characteristics of the policies in the peer group; and  
4        deriving the variables for a selected policy by determining the peer group to which the  
5        selected policy belongs and using the statistics for the policy characteristics for the  
6        peer group to derive the variables for the selected policy.

1        16.    The method of claim 15, further comprising:  
2        updating the lookup table for a peer group of the selected policy using policy  
3        information from the selected policy.

1        17.    The method of claim 1, wherein deriving variables further comprises:  
2        deriving variables from the policy information which compare the selected policy in a  
3        selected time period with the selected policy in a time period prior to the selected  
4        time period.

1        18.    The method of claim 17, wherein deriving variables from the policy information  
2        which compare the selected policy in a selected time period with the selected policy in a time  
3        period prior to the selected time period further comprises:  
4        deriving variables which quantify an amount or distribution of risk-related activities  
5        associated with the policy.

1        19.    The method of claim 17, wherein deriving variables from the policy information  
2        which compare the selected policy in a selected time period with the selected policy in a time  
3        period prior to the selected time period further comprises:  
4        determining at least one measure which is a percentage change in a policy characteristic  
5        between the selected time period and the previous time period.

1           20.     The method of claim 17, wherein deriving variables from the policy information  
2     which compare the selected policy in a selected time period with the selected policy in a time  
3     period prior to the selected time period further comprises:

4                 determining a vector of policy characteristics for the selected time period and a vector of  
5                 the policy characteristics in the prior time period; and  
6                 determining a scalar measure of comparison between the two vectors.

1           21.     The method of claim 20, wherein the scalar measure of comparison between the  
2     two vectors is computed as either a measure of distance between the two vectors or an angle  
3     measure between the two vectors.

1           22.     The method of claim 17, wherein deriving variables from the policy information  
2     which compare the selected policy in a selected time period with the selected policy in a time  
3     period prior to the selected time period further comprises:

4                 determining a percent change in a payroll share in at least one employment  
5                 classification in the selected time period relative to the previous time period.

1           23.     The method of claim 17, wherein deriving variables from the policy information  
2     which compare the selected policy in a selected time period with the selected policy in a time  
3     period prior to the selected time period further comprises:

4                 determining a percent change in a payroll share in an exception group in the selected  
5                 time period relative to the previous time period.

1           24.     The method of claim 17, wherein deriving variables from the policy information  
2     which compare the selected policy in a selected time period with the selected policy in a time  
3     period prior to the selected time period further comprises:

4           determining a vector distance between vectors of payroll percent shares in each of a  
5           plurality of employment classes in the selected time period and in the prior time  
6           period.

1           25.     The method of claim 24, wherein the employment classes are SIC employment  
2     classes.

1           26.     The method of claim 24, wherein the employment class groups are NCCI  
2     employment class groups.

1           27.     The method of claim 24, wherein the employment class groups are rate-driven  
2     employment class groups.

1           28.     The method of claim 24, wherein the employment class groups are data-driven  
2     employment class groups, each group including employment classes that are likely to appear  
3     together in payroll reports.

1           29.     The method of claim 17, wherein deriving variables from the policy information  
2     which compare the selected policy in a selected time period with the selected policy in a time  
3     period prior to the selected time period further comprises:

4           determining a percent change in a number of claims filed on the policy in the selected  
5           time period relative to number of claims filed on the policy in the prior time period.

1           30.     The method of claim 17, wherein deriving variables from the policy information  
2     which compare the selected policy in a selected time period with the selected policy in a time  
3     period prior to the selected time period further comprises:

4           determining a vector distance between a first vector of the number of claims filed in the  
5           selected time period for each of a plurality of injury types and a second vector of the  
6           number of claims filed in the prior time period in each of the plurality of injury  
7           types.

1           31.     The method of claim 1, wherein the insurance policies are workers'  
2     compensation insurance policies and the policy relative information from which the variables  
3     for assessing the policies are derived includes payroll reports for the policyholder.

1           32.     The method of claim 1, further comprising:  
2     deriving direct policy variables which measure characteristics of the policyholder or the  
3     policy itself without comparison to other policies or the same policy in a prior time  
4     period.

1           33.     The method of claim 32 wherein the direct policy variables are selected from the  
2     group consisting of:

3           type of company of the policyholder;  
4           location of the policyholder;  
5           number of employees of the policyholder;  
6           number of policy cancellations;  
7           age of the policy;  
8           industry type of the policyholder;  
9           amount of payroll reported by the policyholder; and

10 distribution of payroll reported by the policyholder with respect to at least one  
11 employment class.

1 34. The method of claim 1, further comprising:  
2 deriving direct claim variables which measure characteristics of claims filed on policy.

1 35. The method of claim 34 wherein the direct claim variables are selected from the  
2 group consisting of:

3 number of claims filed during the selected time period;  
4 dollar amount of claims filed during the selected time period;  
5 type of claims filed during the selected time period;  
6 number of claims filed during the selected time period relative to amount of premium  
7 paid during the selected time period; and  
8 number of claims filed during the selected time period relative to a size of payroll  
9 during the selected time period.

1 36. The method of claim 1, further comprising deriving variables that measure the  
2 probability of fraud in the policy conditionally based on at least one policy characteristic of the  
3 policy.

1 37. The method of claim 1, further comprising:  
2 applying the policy to a plurality of decision rules which identify specific inconsistent or  
3 suspicious policy facts related to the policy, to generate an output indicating which  
4 decision rules were violated by the policy.

1 38. The method of claim 37, wherein the decision rules are derived from statistical  
2 analysis of insurance policies of at least one insurer which have been determined to contain  
3 misrepresented policy information.



1        39.     The method of claim 37, wherein the insurance policies are workers'  
2     compensation insurance policies and wherein the decision rules are selected from a group  
3     consisting of:

4        a decision rule that identifies as potentially fraudulent a policy that has an employment  
5        class code on a claim with an injury date during the selected time period but the  
6        employment class code for the claim is not included in payroll reports for the policy  
7        during the selected time period;

8        a decision rule that identifies as potentially fraudulent a policy that reports zero payroll  
9        during the selected time period but for which one or more certificates of insurance  
10       were issued during the selected time period;

11       a decision rule that identifies as potentially fraudulent a policy that reports zero payroll  
12       during the selected time period but which has at least one claim with an injury date  
13       during the selected time period;

14       a decision rule that identifies as potentially fraudulent a policy with an officer who is  
15       currently or was selectedly an officer on a different policy and where the new policy  
16       has a lower experience modification factor than the prior policy; and

17       a decision rule that identifies as potentially fraudulent a policy that has an employment  
18       class code on a claim and for which no premium was reported at the time the claim  
19       was opened

1       40.     The method of claim 1, further comprising:

2       for each selected policy, determining at least one variable which significantly  
3       contributes to the model score for the policy; and  
4       outputting a reason for the model score with respect to the determined at least one  
5       variable.

1           41.     The method of claim 40, wherein the insurance policies are workers'  
2     compensation insurance policies, and wherein the significant variable is selected from a group  
3     consisting of:  
4           an indication of whether the policy has been previously audited;  
5           an indication of whether a reported payroll has been adjusted;  
6           a number of employment class codes in at least one payroll report of the policyholder  
7                 during the selected time interval;  
8           a type of company of the policyholder;  
9           an age of the policy;  
10          a size of payroll of the policyholder;  
11          a size of a premium paid on the policy;  
12          an industry classification code of the policyholder;  
13          a distribution of payroll in at least one payroll report of the policyholder during the  
14                 selected time interval;  
15          a percent payroll share in a low rated employment class code;  
16          a change in a distribution of payroll in at least one payroll report of the policyholder  
17                 during the selected time interval compared with the prior time period;  
18          a change in an exception group payroll share in at least one payroll report of the  
19                 policyholder during the selected time interval compared with the prior time period;  
20          a payroll share in a group of agriculture related employment classes;  
21          a payroll share in a group of construction related employment classes;  
22          a payroll share in a group of manufacturing related employment classes;  
23          a payroll share in a group of government related employment classes;  
24          a payroll share in at least one clerical employment classes;  
25          a number of prior cancellations of the policy;

26 a ratio of the number of claims made on the policy to a size of the payroll of the  
27 policyholder; and  
28 a number of claims on the policy during the selected time interval.

1 42. A method for training a neural network on a plurality of observations to score  
2 the observations on a dependent variable, each observation including an independent variable  
3 having an original value that is highly correlated with the dependent variable, so as to calibrate  
4 the influence of the independent variable on scores, the method comprising:

5 for each of the plurality of observations, setting the independent variable to a randomly  
6 selected value, and providing the observations to the neural network a first time,  
7 wherein the neural network establishes connection weights based on the provided  
8 observations to output an un-calibrated score for an observation; and

9 for each of the plurality of observations, setting the independent variable to its original  
10 value in the observation, and providing the observations to the neural network a  
11 second time, wherein the neural network adjusts the connection weights to calibrate  
12 the output scores with respect to the independent variable.

1 43. The method of claim 42, wherein the independent variable is a Boolean variable  
2 having two defined values, and the randomly set value is between the two defines values of the  
3 Boolean variable.

1 44. The method of claim 42, wherein the independent variable is a continuous  
2 variable having a range of values, and the randomly set value is within the range of values.

1 45. A method of estimating a quantity corresponding to a set of entities grouped  
2 using one or more hierarchical categories, the method comprising:  
3 determining an estimate of the quantity for a first category corresponding to the highest  
4 level of the hierarchy; and

5 for each subsequent category representing a current, lower level of the hierarchy,  
6 adjusting the estimate of the quantity using an estimate for the current level and the  
7 estimate of the higher level.

1 46. The method of claim 45, wherein the quantity being estimated is a risk factor,  
2 and each category of the hierarchy has a value for the risk factor.

1 47. The method of claim 45, wherein the hierarchy of categories are Standard  
2 Industry Classification codes (SIC), and the quantity being estimated is risk factor associated  
3 with each SIC code.

1 48. The method of claim 45, wherein adjusting the estimate of the quantity  
2 comprises applying a Bayesian adjustment to the estimate using the estimate for the current  
3 level of the hierarchy and the estimate of the quantity from the higher level.  
4

1 49. A system for detecting premium fraud in an insurance policy, comprising:  
2 a database of insurance policies, each policy associated with a policyholder and having  
3 policy related data;  
4 a policy selection process that selects from the database a number of policies for scoring;  
5 a variable derivation process that derives for each of the selected policies variables  
6 associated with the policyholder of the policy for comparing the policy to peer  
7 group policies, and variables for comparing the policy in a selected time period with  
8 the policy a time period prior to the selected time period; and  
9 a fraud detection module that receives for each policy the derived variables and  
10 generates a score indicating the likelihood of misrepresentation of policy  
11 information by the policyholder of the policy.

1        50.     The method of claim 49, wherein the fraud detection module further comprises:  
2        a predictive model that generates a model score indicating a relative likelihood of  
3        misrepresentation of policy information by the policyholder; and  
4        a post scoring process that converts the model score into the fraud score indicating a  
5        probability of misrepresentation of policy information.

1        51.     The system of claim 50, wherein the post scoring process converts the model  
2        score into an expected adjustment of premium for a policy.

1        52.     The system of claim 50, further comprising:  
2        a rule-based process that applies a plurality of rules to a selected policy to identify  
3        policies suspected of premium fraud based on inconsistent or incomplete policy  
4        related information.

1        53.     A method for determining a usage strategy for processing insurance policies  
2        suspected of premium fraud, the suspected policies selected from a plurality of insurance  
3        policies, the method comprising:  
4        establishing a frequency for scoring the plurality of insurance policies to obtain for each  
5        policy a score indicating a relative likelihood of premium fraud in the policy;  
6        establishing a ranking function for ranking the scored policies; and  
7        establishing a plurality of threshold scores, and for each threshold score, defining an  
8        audit action for performing on policies which have a score exceeding the threshold  
9        score, but not exceeding a next greater threshold score.

1        54.     The method of claim 53, wherein establishing a ranking function for ranking the  
2        scored policies further comprises:  
3        ranking the scored policies according to their scores.

1           55.     The method of claim 53, wherein establishing a ranking function for ranking the  
2 scored policies further comprises:

3           ranking the scored policies according to an expected adjusted premium.

1           56.     The method of claim 53, wherein establishing a plurality of threshold scores  
2 further comprises:

3           establishing a first threshold score for selecting for a desk audit those policies having a  
4           score exceeding the first threshold score; and

5           establishing a second threshold score for selecting for a field audit those policies having  
6           a score exceeding the second threshold score, wherein the second threshold score is  
7           greater than the first threshold score.

1           57.     The method of claim 53, further comprising:

2           establishing a set of rules for identifying policies suspected of premium fraud.

1           58.     The method of claim 53, further comprising:

2           establishing a plurality of reason codes, each reason code providing an explanation for a  
3           policy receiving a score; and

4           establishing for each of number of reason codes, at least one audit action to be taken in  
5           response to a policy having a score which produces the reason code.

1           59.     A method for processing insurance policies suspected of premium fraud, the  
2 method comprising:

3           scoring each of a plurality of insurance policies with predictive model to generate for

4           each policy a score indicating a relative likelihood of premium fraud;

5           ranking the scored policies according to the scores;

6 selecting for a desk audit those policies having a score exceeding a first threshold score;  
7 and  
8 selecting for a field audit those policies having a score exceeding a second threshold  
9 score, wherein the second threshold score is greater than the first threshold score.

1 60. A method for processing insurance policies suspected of premium fraud, the  
2 method comprising:

3 scoring each of a plurality of insurance policies with predictive model to generate for  
4 each policy a score indicating a relative likelihood of premium fraud;  
5 determining for each scored policy an expected premium adjustment;  
6 ranking the scored policies according to their expected premium adjustments;  
7 selecting for a desk audit those policies having an expected premium adjustment  
8 exceeding a first threshold amount; and  
9 selecting for a field audit those policies having a expected premium adjustment  
10 exceeding a second threshold amount, wherein the second threshold amount is  
11 greater than the first threshold amount.

1 61. A method of developing a predictive model of insurance premium fraud, the  
2 method comprising:

3 collecting from at least one insurance company policy information for a plurality of  
4 insurance policies;  
5 determining for each policy a scoring period for scoring the policy;  
6 selecting a training set of policies;  
7 deriving for each policy in the training set a plurality of variables from the policy  
8 information and from other information relevant to policy premiums;  
9 applying the derived variables to an untrained predictive model to train the predictive  
10 model to produce a measure with respect to whether the policies are fraudulent or  
11 non-fraudulent during their respective scoring periods ; and

12 selecting a subset of the derived variables for the using in the predictive model, which  
13 variables significantly contribute to a prediction of whether a policy is fraudulent  
14 during its scoring period.

1 62. The method of claim 61, wherein the insurance policies are workers' compensation  
2 insurance policies, further comprising:  
3 excluding from the training set policies for which no payroll is reported during the  
4 scoring period for the policy.

1 63. The method of claim 61, further comprising:  
2 tagging each of the policies to indicate whether the policy is fraudulent, non-fraudulent,  
3 or indeterminate; and  
4 excluding from the training set policies which are tagged as indeterminate.

1 64. The method of claim 61, further comprising:  
2 for each policy in the training set, providing a random value for the previously audited  
3 variable, and applying the derived variables and the random value of the previously  
4 audited variable to the predictive model; and  
5 for each policy in the training set, providing an actual value for the previously audited  
6 variable indicating whether the policy was previously audited for the scoring  
7 period, and applying the derived variables and the actual value of the previously  
8 audited variable to calibrate the scores produced by the predictive model.  
9